ICT in a Developing Country Context: An Indian Case Study

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I: The Perceived Opportunity

India's information and communication technology (ICT) sector is seen as epitomising the opportunity that globalisation offers a low-income developing country. The success of Indian techno-entrepreneurs in the US and the rapid growth of the Indian software and IT-enabled services industries, especially its export segment, have buoyed expectations of the potential for growth and human development that ICT holds out. If India-trained hardware and software technologists can dominate the industry in Silicon Valley and elsewhere in the US and if entrepreneurs of Indian origin can play a leading role in the new wealth being created in the new economy there, the argument goes, it should be possible for India to harness these skills to earn foreign revenues, spur domestic growth and ensure substantial welfare gains. Implicit in such reasoning are judgements about the potential that ICT holds out, about the ability of a developing country like India to exploit that potential and about the possibilities of overcoming any constraints to the realisation of that potential. One of the objectives of this study is to examine the basis for each of these sets of judgements.

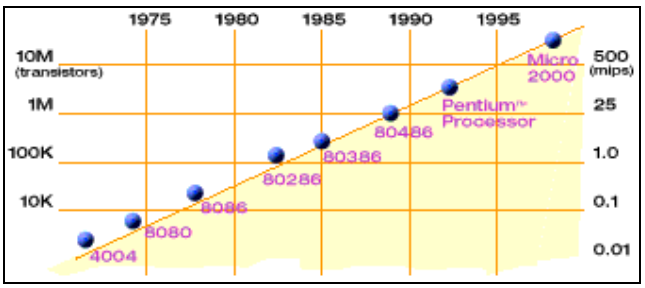
Developments in three directions are expected to help realise the potential that ICT holds out for a developing country like India. First, given her presumed advantages in this rapidly growing sector, India is expected to register significant export gains that would result in substantial increases in income and employment. This opens up the possibility of a period of rapid, ICT-led growth that facilitates the effort to improve upon India's limited human development achievements. Second, the use of relatively cheap ICT skills in the restructuring and reorganisation of the "brick-and-mortar" economy and in diversifying the structure of economic activity is expected to ensure the horizontal diffusion of these benefits. This would ensure that sectors transformed by the ICT revolution do not become "enclaves" and that there is a cumulative spread of the benefits derived from the new technologies. Third, the new technologies are expected to directly improve human development through the application of highly developed and dispersed ICT skills to improving governance, facilitating the empowerment of poorer households and communities and rendering the delivery of the benefits of extension programmes and welfare schemes more transparent and efficient. A second objective of the study is to assess possibilities on each of these fronts, examine the constraints to the realisation of such possibilities and discuss the policy initiatives that may help further that realisation.

The Potential

Developments in information and communication technologies during the last quarter of the 20th century are widely seen as having heralded an information age in which economic and social activity has been widened, deepened and transformed. Optimistic projections would have it that a computerised and networked world would not only change work practices, attitudes to leisure and life styles, but also allow for a more widespread and rapid growth of employment, productivity and output. That is, these technologies are seen as having both the potential to advance human development as well as spread the capabilities to benefit from that potential.

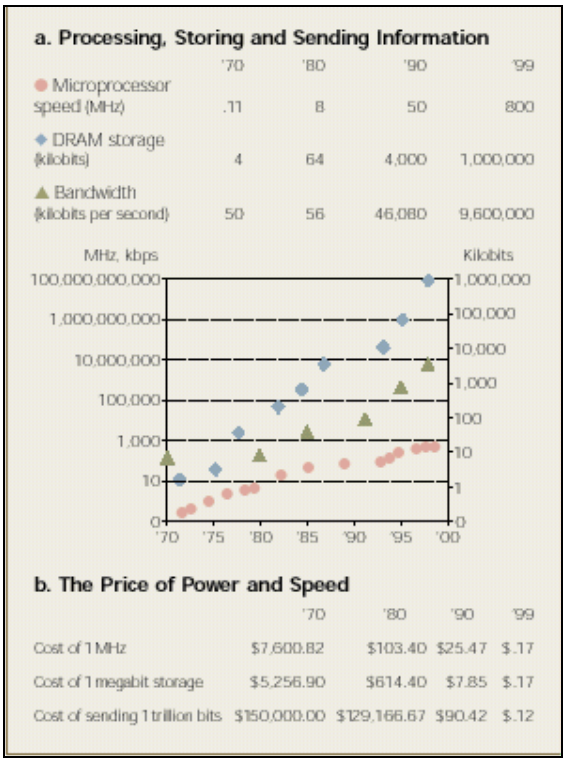
At the core of this perceived transformation lies the dramatic increase in computing power ensured by the emergence and rapid evolution of microprocessor technology. The pace of this increase is captured by the oft-quoted observation made by Gordon Moore as early as 1965 that newer chips that entered commercial production every 18-24 months incorporated twice the number of transistors as their predecessor. That trend has since persisted (see Graph 1) and has been given the status of a law – termed Moore's law – by industry observers. As a result in the three decades starting 1971 the number of transistors on a chip increased from 2,300 on the 4004 to 26 million on the Pentium III processor and the cost of a Mhz of computing power has fallen from $760 in 1970 to 17 cents in 1999 (Charts 1 and 2). This has helped PC makers and those incorporating computer chips into their products deliver far more powerful systems at the same or declining prices.

Graph 1: Moore's Law: The growth in computing power



Source: Website at http://www.intel.com/pressroom/kits/bios/moore.htm

Graph 2: Trends in the Costs of Computing Capacity



Source: Federal Reserve Bank of Dallas, **Annual Report 1999**.

The growth in computing power has triggered a veritable race at developing digital devices that can exploit that power and offering peripherals that extend that capability. These devices acquire, record, organise, retrieve, display and disseminate information. Here too technological change has reduced costs substantially. The cost of a megabit of storage has fallen from $5257 in 1970 to 17 cents in 1999. Computing devices also help manipulate and modify stored information, by searching through the information, displaying them in a chosen format, performing simple and complex scientific and engineering calculations and solving a range of non-numerical problems. The power that this offers is considerably enhanced by the growing possibility of linking computing devices and allowing them to communicate with each other based on some common protocol. This process as been aided by improvements in communication technology that have reduced the cost of transmitting a trillion bits of information from $150,000 to 12 cents over the last three decades.[1]

The wide availability of enhanced computing power and the consequent ability of networked individuals, households, organisations and institutions to process and execute a huge number of instructions in imperceptible time spans can have revolutionary implications. *First, it has the potential of creating and massively expanding industries catering to the market for a range of computing devices*, especially personal computers, that have now become accessories in the home and not just at the work place. This has already led to the burgeoning of the industry that produces the hardware and software needed to allow individuals, organisations, small businesses and corporations to directly exploit the benefits of the dramatic expansion in computing power.

Second, it paves the way for changes in the nature of a whole range of products varying from televisions and microwave ovens to automobiles and aircraft, as well stimulates many new product innovations, such as cellular telephones and palm-sized personal organisers. The stimulus to innovation in sectors completely outside the computing business itself, resulting in the emergence, creation and servicing of a host of new needs, makes the employment consequences of the new technologies virtually impossible to calculate.

Third, it can substantially transform industrial processes, since firms can now use the capacity to store information and execute instructions to automate and change the manner in which they conduct and manage their operations. Information technology is in part revolutionary because it ensures and necessitates the transformation of productive capacity in almost all sectors. The most obvious impact of the computing revolution is in the workplace. Computers with word-processing packages that have rendered the creation, modification and manipulation of design-wise, versatile documents extremely easy, have replaced the typewriter. They have also allowed the creation and manipulation of databases that render a range of activities such as accounting, inventory management and the like most simple. These changes have substantially enhanced the efficiency and productivity of office work, so long as the cost of acquiring and routinely upgrading the required hardware and software and training workers to use the new technology is borne.

In manufacturing too, processes are increasingly computer-aided, through the incorporation of the chip into equipment of various kinds and the application of various developments in computer science to support manufacturing activities. Computerisation helps integrate design and production at the shop floor allowing for greater flexibility in responding to variations in demand. It allows firms to link inventory information to the real time consumption of intermediates and production of outputs, thereby reducing inventory levels and reducing costs. It permits firms to automate inspection and ensure better quality. It supports systems that can track production processes, diagnose bottlenecks and breakdowns and reduce downtime. In

[1] For a descriptive survey of computing and information technology refer various reference at www.brittanica.com.

principle, therefore, costs can be reduced and quality improved substantially, even while production is speeded up.

Finally, the computing revolution leads to a dramatic expansion of the size and scope of the services sector (across a wide spectrum including finance, banking, trade, entertainment and education). This results partly from associated technological developments that find new uses for the massive computing power that is cheaply available, partly from the huge market that developments in communications and networking technology create, and partly from the fact that the increasingly ubiquitous PC becomes the vehicle to deliver a range of services, besides being a device in its own right. The microprocessor is not just the core of the IT revolution, but stands at the centre of the convergence of the information, communication and entertainment sectors.

When all of these benefits are combined with developments in communication, individuals, organisations and corporations are able to both secure a presence on the web as well as easily traverse cyberspace. This creates the basis for establishing links between individuals, individuals and government agencies, individuals and business, business and government and business and business. The full consequences of this ***compacting of economic space*** resulting from the internet's transformation from a channel of communication between few scientists to a web linking economic and social agents of different kinds are even now only being absorbed and analysed. One area where the effects are tangible is electronic commerce, which allows for trading in virtual space, reduces transaction costs, cuts down on retail infrastructure and slashes retail margins.

Seen in these terms the ICT revolution has both a direct and indirect growth-inducing role. Directly, falling costs of computing power and communications and new activities and innovations resulting from this technological advance provides new incentives to invest. Such investment, by increasing productivity, further spurs growth. And inasmuch as the availability of information technology facilitates the act of innovation this process can prove to be cumulative.

Implications for Developing Countries

From the point of view of developing countries searching for ways to narrow the global income gap, the growth-inducing potential of ICT is an obvious attraction. And for those who complain that growth does not automatically lead to poverty reduction, ICT offers the promise of improving the efficiency of and better targeting the delivery of the benefits of rural and urban development programmes and poverty alleviation schemes. The real question is whether the ICT revolution would diffuse its way into the less developed world. It will, argue protagonists, because there are a range of factors favouring such diffusion, even though the major innovations underlying that revolution have thus far occurred in the developed economies. In fact, *the wide-ranging expansion of the information technology sector has generated a new optimism with regard to the prospects for developing countries within the current world order*. That optimism has many sources. To start with, it stems from the understanding that, *unlike the 'routinised' technologies which dominated development during the immediate post-World War II years, the new 'entrepreneurial' technologies driving the IT sector are seen as being characterised by a knowledge-base for innovation that is more rapidly transmitted across the globe, and levels of investment that are much lower and often easily afforded by even private investors in developing countries*. This substantially reduces barriers to entry and facilitates the presence of small players from developing countries in a rapidly expanding segment of the global economy.[2] Further, since much of IT production from assembly to software generation is

[2] For example, the 1999 Annual Report of the Federal Reserve Bank of Dallas (Cox and Alm, 2000) argues as follows: "What's different about the New Economy? There's an unbridled dynamism, flowing from an entrepreneurial capitalism. A novel idea and a little money can spark a billion dollar business overnight. Yesterday's economy was dominated by establishment capitalism, with high

skilled-labour intensive, the availability of cheap skilled labour in countries like India is seen as giving them a decisive edge in the international competitive battle in this sector.

Routinised technologies, such as those characteristic of the 'older' steel and chemical industries, were embodied in large continuous process plants requiring 'lumpy' investments in innovation, commercialisation, capacity creation and market acquisition. This made access to a critical size of capital crucial for entry, queering the pitch for the big players from the developed industrial countries. Moreover, dramatic innovations in these sectors were few and far between, with much technological development consisting of marginal changes that were cumulatively, rather than instantaneously, significant. These marginal changes were, in turn, very often stimulated by knowledge gained in the act of production, which led up to expensive R&D exercises that created new commercially-usable knowledge. Thus, not only were these industries dominated by big firms created with lumpy investments, but much of the technological change that occurred in the industry originated within or as a result of the activity of these big firms themselves. Entry into the industry by new, especially small new, players was rare. Competition was restricted to that between the dominant oligopolistic firms straddling domestic and world markets. To the extent that technological change could trigger a competitive challenge from outside the industry, this was largely the result of the emergence of substitute products or wholly new industries that rendered the older industries less significant or even irrelevant.

As compared with this the IT sector is seen as characterised by low costs of entry and an easily accessed and almost universally available knowledge-base for innovation. What is of special significance is that the sources of this knowledge in a significant segment of the hardware and software industries are conventional routes such as journals, conferences, seminars and publicly or privately financed training programmes. This makes it easy for wholly new entrants to acquire the knowledge base required for cutting edge technological contributions to the industry, as was and is true of at least some of the myriad start-ups in Silicon Valley.

In the hardware segment, the production of a range of products varying from components like printed circuit boards to peripherals like modems, on the one hand, and the assembly of personal computers, on the other, do not require large investments for entry. Many of these are heterogeneous products that can be put together on the basis of a combination of internally produced and externally sourced intermediates and components. There are no doubt some components entering into ICT hardware, such as the microprocessor, the production of which is capital intensive in nature, and dominated by a few global players like AMD, Intel and Motorola. But this does not preclude the presence of smaller players in important 'downstream' industries, since such components can be sourced from outside producers, even if located abroad, as is the norm in the computer industry worldwide. The real 'technology' in these downstream areas is a system architecture that maximises the benefit derived from an appropriate combination of sub-systems, components and peripherals. That is, the heterogeneous nature of the product allows a producer to restrict his own production activity to a sub-set of the total elements that enter the product and/or just the design and assembly of the final product.[3] This requires that the technology in the sense of the knowledge for system

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barriers to entry that disadvantaged newcomers and new products. Economic change occurred at a slower pace." Interestingly, the same authors go on to say that "Increasing returns to scale pervade the New Economy," making the argument about easy entry a bit difficult to swallow. For a more academic analysis in the Indian context refer, Hans-Peter Brunner, **Closing the Technology Gap: Technological Change in India's Computer** Industry, New Delhi: Sage Publications, 1995.

[3] In India, for example, the Centre for Development of Telecommunications (C-DOT) designed, developed and patented a switching system more suited to environments characterised by low telephone densities and low call densities than is the case with switching systems imported from

design is freely available and is easily appropriated. But once such technology is available, the investment required for entry can be kept to the minimum, with labour intensive assembly often involving negligible investment in capital equipment. This allows for easy entry even on the part of small developing-country producers and partly allows for the emergence of international brands from the developing world, as is true of Acer from Taiwan. What is crucial here is access to outsource components ensured, *inter alia*, by a liberal import regime. The freeing of access to imported components has therefore, facilitated the growth of the computer industry in countries like India.

The logic of easy entry is even truer of the software sector, where knowledge is easily acquired and innovations easily replicated, and which is skilled-labour intensive and requires little by way of capital investment. Not surprisingly, over the years the software segment of the IT sector has come to dominate the industry in India. As Table 1, which details the structure of the Indian IT industry in 1999-00 shows, domestic spending accounted for a little less than half of total IT demand. Within the domestic market, expenditure on software accounts for 44 per cent of the total. If we add revenues from software exports to domestic software spending, it should be clear that the software market dominates the industry. And, software is the segment where the advantages of easy technology access and low entry-level investments are most prevalent.

Table 1: Structure of the Indian IT Sector 1999-00
(Rs. Million)

Domestic Hardware Market	92,800
Domestic Software Market	72,580
Software Exports	171,500

Source: National Association of Software and Service Companies (NASSCOM) Website (www.nasscom.org)

Finally, *the ICT revolution has opened up whole new opportunities for developing countries in the services sector*. Prior to the digital revolution's transformation of service activity, the provision of most services required the presence of a service provider at the point of delivery of the service. As a result, services export took the form of migration of personnel to the location where the service was provided, as epitomised by the migration of skilled technicians, doctors and nurses to the US and of semi-skilled and unskilled workers, including carpenters, masons, chauffeurs and housemaids to the Gulf countries from India. Benefits to the home country came in the form of *remittances* of hard currency earnings by these migrants to their families, which augmented the scarce pool of foreign exchange available to these countries. But the magnitude of such income was limited by the restrictions on the movement of skilled and semi-skilled and unskilled personnel set by the immigration laws and practices of countries where the relevant service demand originated.

The digital revolution has changed all that. Now there is a range of services being provided by workers located in a country different from the one in which the service is actually delivered. These services are delivered via telecommunication or data networks, and are either *outsourced* or organised by agents in the country of origin of the service to whom the provision of these services are contracted out or *outlocated* by subsidiaries of corporations from the country of delivery of certain services. Examples of services outsourced include the processing of credit

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abroad. Much of the hardware needed for these rural automatic exchanges was sourced from other domestic producers or imported from abroad.

card accounts, insurance claims and business payrolls; the creation and maintenance of information bases in the form of networked data centres and their use in the provision of information services such as help desks; and the provision of a range of business services such as customer services, financial services and human resource management services. The outsourcing market is currently estimate at over $100 billion in value.

Examples of outlocation are also many. India's apex software and service providers association NASSCOM provides the following examples[4]: "Bechtel has set up its own engineering design subsidiary in New Delhi. Over 500 employees in this subsidiary provide engineering design services to Bechtel customers over telecom and data networks. The benefits for Bechtel are twofold: the company's transaction and salary costs are greatly reduced; and it can now cover customers in different time zones.

"GE Capital has also set up a subsidiary in Gurgaon, New Delhi, to manage payroll accounting and call centres, and to process mortgage-based loans and insurance claims. The subsidiary employs 1000 people; this number is expected to rise to 3,000 by the end of 2000.

"Similarly, British Airways' subsidiary, World Network Services, handles an array of back office jobs for its parent and other airlines, such as dealing with errors in the automatic reservation system and keeping track of frequent flier miles. It employs 750 people and is expected to hire 800 more."

"Other organisations obtaining IT-enabled services are US Hospitals, which obtain medical transcriptions services from Healthscribe in Bangalore; 3Com, which obtains call centre billing and customer care services from Convergys (in the US) and several leading US banks, which have outlocated their Human Resource, customer services, telemarketing, and shared administration for Europe and North America to the International Financial Services Centre, Dublin."

Medical transcription meets at low cost the need set by the medicare system in the US for detail patient treatment records. Doctors dictate the relevant entries and the spoken word is digitsed and transmitted to locations in India where they are immediately transcribed into wordprocessed files that, given the time difference between the two countries, is available to the doctor concerned the very next morning for correction and finalisation.

The possible range of IT-enabled services in an environment where the service sector's role is growing worldwide is immense. The reasons why such relocation occurs are obvious. It substantially reduces the cost at which such services are obtained or provided, and so long as an appropriate location in terms of the availability of manpower with the requisite skills (say, software capabilities) and the necessary characteristics (e.g., knowledge of English) is chosen the quality and efficiency of the service is also ensured. Market research and website design and maintenance services are examples of new growth areas in the immediate future.

As mentioned earlier these services can be managed by third-parties in the developing countries or by firms created by foreign direct investment. According to a McKinsey study undertaken for NASSCOM, call centres and animation are currently the largest opportunities, accounting for 85% of all IT-enabled services. By 2008, the overall turnover of IT-enabled service opportunities for India is expected to amount to approximately $140 billion, with the contribution made by the top five opportunities estimated as follows:

[4] Refer "IT Enabled Services" available on the NASSCOM website at www.nasscom.org.

Table 2: Estimated Turnover of top 5 IT-enabled opportunities in India in 2008	
Human Resource services	$44 billion
Customer interaction services	$33 billion
Finance and accounting	$15 billion
Data search, integration and analysis	$18 billion
Remote education	$15 billion.
Source: NASSCOM at www.nasscom.org	

Those who support the case for encouraging IT-enabled services argue that the offshore economics of IT-enabled services are as good as or even better than those of IT services. Revenues per employee in IT-enabled services, they argue, are in many areas comparable with those of IT services. Further, with the salaries of software professionals rising more rapidly because of demands generated from abroad for IT workers, the competitive advantage deriving from low costs in this sector is seen to be more stable.

It should be clear that so long as the necessary infrastructure in the form of high-speed data-communication links are available, entry into the IT-enabled services sector requires relatively low levels of investment. In addition, a country like India has definite advantages given the adequate supply of English-educated and computer-literate workers at its disposal, since currently the main demand for these services come from the US. As the language requirements for these services widen, other nations can benefit from the emerging demand as well.

Impact on growth and international inequality

The implications of these new opportunities generated by the diffusion of information and communication technologies in the hardware, software and IT-enabled services sectors are obvious. To start with, they offer a whole new range of income-generating sources of employment for labour surplus economies where there are definite signs of a decline in the employment elasticities of output in the conventional commodity producing sectors such as agriculture and manufacturing. In fact, in these sectors, the available evidence seems to suggest that trade liberalisation in the form of removal of quota restrictions and reductions in tariffs, necessitated in part by WTO norms, are resulting in the displacement of more workers in traditional activities than are being created in newer ones. Further, the promised expansion in exports as a result of the restructuring of commodity production by liberalisation has not been realised despite ten years of reform in a country like India. In the circumstances, the fact that the new sectors offer a combination of employment opportunities and export revenues from hardware, software and IT-enabled services, renders them the leaders in the effort to make globalisation the appropriate means to enhance growth in output and employment as well as to reduce balance of payments vulnerability. To boot, industry and government projections[5] of the likely trends in output, exports and employment, are extremely optimistic. According to a study undertaken by McKinsey for NASSCOM[6], India has the potential of raising export

[5] The government's projections are available in Government of India, Ministry of Information Technology, **Annual Report 1999-2000**, Minstry of Information Technology: New Delhi, 2000 and in the **Information Technology Action Plan** available at www.indiatimes.com.

[6] Refer **Highlights of the NASSCOM-McKinsey Study Report 1999** at www.nasscom.org.

revenues from software and IT-enabled services from its 1999-00 level of $4 billion to $50 billion in 2008. This would take the size of the industry from $3.3 billion in 1998 to $87 billion in 2008, along a trajectory involving a compound annual rate of growth of 40 per cent. As a result, the IT sector's contribution to GDP growth is expected to touch 7.5 per cent and its share in India's exports to reach 30 per cent as compared with around 5 per cent currently. Such growth is expected to have substantial employment implications, with employment in the software industry alone projected to rise from its 1997-98 level of 180,000 to 2.2 million in 2008. This makes the projected increase in employment in the software sector greater than the increase in total organised public and private sector employment of 181,300 between 1990 and 1998. If the McKinsey projections are realised employment in the software sector in 2008 would be around 8 per cent of India's organised sector employment in 1998. To this we should add the projection that direct and indirect employment in the hardware sector is expected to touch 1.6 million and 3.2 million respectively, taking total IT employment to 7 million in 2008.

Such optimistic projections lead up to another conclusion. Since these activities, especially hardware and software development, are areas which are among the most dynamic in the global economy and in which there are ostensibly fewer technological barriers to successful entry on the part of small firms in general and small firms from developing countries in particular, the evidence of a rapid expansion in the contribution of these sectors to output, employment and exports in developing countries is seen as the basis for a redistribution, at the margin, of the benefits of world development to the less developed countries. That is the ICT revolution could impact on development in a manner in which it would reshape the international economic order in a more egalitarian direction.

Human Development Benefits

But that is not all. Besides giving rise to the possibility of increasing income and employment, protagonists would argue that ICT developments could contribute directly to human development. As developing countries build their capabilities to exploit the new technologies and as these technologies become more accessible in these countries, the argument goes, they can be put to use in a more direct manner to empower people, improve social service provision and alleviate poverty. There are many ways in which these possibilities are being currently experimented with. To start with, a system of networked and interactive computers providing constantly updated information is seen as conducive to better decision-making as well as to a more citizen-friendly mode of governance. There are a number of micro-level experiments underway in different parts of India, aiming to realise this potential of ICT. This is the objective underlying the talk about 'e-governance' in many developing country environments. A case in point is the disaster management project, developed as part of the Maharshtra Emergency Earthquake Rehabilitation Project (MEERP), being implemented in the State of Maharashtra, aimed at minimising the adverse effects of natural disasters.[7] Complete with a disaster management centre located at the Yashwantrao Chavan Academy of Development Administration (YASHADA), computerised control rooms across the state, a VSAT- and VHF-based communication network and area-specific, Geograhical Information System (GIS)-based, disaster-management plans, the system provides critical support for the disaster management functions of the administration. It would help plan exit and evacuation activities in case of natural or man-made disasters, locate resources that could be easily and quickly deployed in the affected areas and identify potential disaster management facilities in case of need. Supported by

[7] Refer Krishna S. Vatsa, "Technological Challenges of the Disaster Management Plan for the State of Maharashtra", in Subhash Bhatnagar and Robert Schware (eds.), **Information and Communication Technology in Development; Cases from India**, New Delhi: Sage Publications, 2000, pp. 50-62.

the World Bank, the DFID and the UNDP, the project is now reportedly complete in all districts across the state.

Another similar example is the computerisation of the *Mandal* Revenue Offices (MROs) in the State of Andhra Pradesh. As part of the project all the MROs (totalling 1124), the revenue divisional offices (78), the collectorates (23), the office of the commissioner of land revenue, and the directorate of economics and statistics at Hyderabad are to be computeruised. This involves data collection, development and implementation of appropriate databases and developing human resources through intensive training. Here to, a substantial part of the funding comes from a World Bank Hazard Mitigation and Emergency Cyclone Recovery Project, "which supports the government's efforts to improve data collection and communication of relevant hazard and vulnerability reduction information from the district and mandal level to citizens."[8]

The system is expected to automate and facilitate:

- The maintenance of statistical information on population, landholding, cropping patterns, weather and climate, livestock, irrigation facilities, housing and a range of other economic information needed for design and management of development schemes.
- The issue of integrated certificates (detailing caste, place and date of birth), birth and death certificates, income certificates, pensions and ration cards.
- The maintenance of village records, including records relating to transfer of land rights, revenue demands, and allocation of government/surplus lands.
- The monitoring of public grievances, welfare schemes, hazard mitigation plans and rescue operations.
- The monitoring the performance of every employee of the state government.

The system sits on the Andhra Pradesh Statewide Area Network (APSWAN), which uses a 2MBP optic fibre link to connect the state secretariat with 23 district headquarters. Voice, video and data services made possible by this backbone is expected to ensure better coordination between state headquarters and district offices and improve the efficacy of the different regulatory, developmental and hazard mitigation programmes of the state government.

The storage of a wide range of information, including documents relating to property rights in computerised databases and providing public access to these databases is seen as promoting transparency of a kind that strengthens democracy, empowers people and speeds up decision-making when compared with a situation where information was sealed into files locked with red tape that were accessible only to a bureaucracy sworn to secrecy on all matters.

A more decentralised, village level project aimed at carrying computers to the rural and semi-urban areas is the model, "wired village" project implemented around Warana Nagar in the Kolhapur and Sangli districts of Maharashtra.[9] It was designed as a pilot project aimed at

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[8] Refer Asok Kumar, "Computerisation of *Mandal* Revenue Offices in Andhra Pradesh: Integrated Certificate Application", in Subhash Bhatnagar and Robert Schware (eds.), **Information and Communication Technology in Development; Cases from India**, New Delhi: Sage Publications, 2000, pp. 105-112.

[9] N. Vijayaditya, "A Wired Village: The Warana Experiment", in Subhash Bhatnagar and Robert Schware (eds.), **Information and Communication Technology in Development; Cases from India**, New Delhi: Sage Publications, 2000, pp. 132-140.

demonstrating the contribution an IT infrastructure can make to the socio-economic development of a cluster of 70 contiguous villages. The project aims to:

- increase the efficiency and productivity of the existing cooperative enterprise by setting up a communications network;
- provide agricultural, medical and educational information to villagers at facilitation booths in their villages;
- provide communication facilities at these booths to link the villages to the Warana Cooperative Complex;
- provide villagers access to the Internet via the National Informatics Centre Network (NICNET)
- provide distance education facilities to both primary and higher educational institutes; and
- establish a Geographical Information System of the 70 villages and facilitate and render transparent their administration, especially in matters relating to land.

The Warana project is jointly implemented by the National Informatics Centre (acting on behalf of the central government), the Government of Maharashtra and the Warana *Vibhag Shikshan Mandal* under the educational department. The estimated cost of the project of around $600,000 (Rs.2.6 crores) was also jointly financed by the central government (50 per cent), the Government of Maharashtra (40 per cent) and the *Warana Vibhag Shikshan Mandal* (10 per cent).

A second set of experiments relate to the effort to increase the efficacy of social service delivery through the use of ICT. A remarkable pilot project along these lines was the Indian Healthcare Project begun in 1994 as a collaborative project involving the Government of India, Apple Computer Inc. and CMC Ltd in the state of Rajasthan.[10] It targeted the Auxiliary Nurse Midwives (ANMs) who were healthcare workers responsible for 5000 persons distributed over several villages. The ANM is expected to call on each household under her charge once a month to collect demographic data, administer immunisation facilities, and provide counselling on family welfare and mother-child health programmes.

The project sought to combine the use of an IT device and relvant support tools to:

- reduce time spent doing paperwork by ANMs
- increase the accuracy of the data collated and supplied by the ANMs
- ensure availability of village level healthcare data in an electronic form
- provide the ANM with information that helps her provide more effective services.

The pilot project team designed a system based on the Newton handheld computing platform and at the end of the research phase turned over the results to CMC Lt for further development.

Finally, experiments are on to provide computer access at the village level, which facilitates not merely extension services on technical matters relating to best agricultural practices or combating pest attacks, but also provides ready access to information on market conditions, opportunities and prices that allow small farmers to maximise incomes from their output. In

[10] Refer Naresh Kumar Reddy and Mike Graves, "Electronic Support for Rural Healthcare Workers", in Subhash Bhatnagar and Robert Schware (eds.), **Information and Communication Technology in Development; Cases from India**, New Delhi: Sage Publications, 2000, pp. 35-49.

Embalam, India, "a two-street village 22km west of Pondicherry, where 130 out of 210 families struggle below the poverty line", the village elders have allowed the M.S. Swaminathan Foundation access to one side of the temple to house two solar-powered computers that are used to give villagers a wealth of data, varying from the price of rice to weather conditions for fishermen and medical information for the sick. Embalam is one of four villages in which the M.S. Swaminathan Foundation is implementing the "information village" project. The project aims to use "science and technology to tackle poverty, with a $120,000 grant from the Canadian government. The foundation provides villages with free technology and information in exchange for the villages' promise to house the computers and staff their operation." Through the project "farmers have gained a better grip on their local markets as prices are more transparent. They get the right seeds when they want them; they have catalogued over 350 different types of herbs that can grow in their area. Fishermen get information from satellite images on where the fish shoals are likely off the Pondicherry coast, and (from a United States Navy Web site) on wave heights and wind directions in the Bay of Bengal."[11]

Another such project is the model computer project in the state of Madhya Pradesh, which is revenue generating and does not depend on state funds. In Dhar district, "one of India's poorest, young men have a franchise from the state to distribute daily crop prices and commonly needed state records. 22 villages have each bought a computer, a modem, a printer and a battery for $1500 with their own money and have agreed to provide a small booth to house the setup.

In each case, the state then picked a young person from the village with at least a 10th grade education to operate the computer and gave him a franchise to sell information from the state's computer network. For 25 to 35 cents, villagers buy printouts of documents that they might have spent days trying to get from local bureaucrats: land records, caste certificates and proof of income, among others. For another 25cents, any citizen can send a complaint to the state by e-mail – my pension didn't arrive, my child's teacher didn't show up, my village hand pump doesn't work – and the state guarantees a reply. And for 10 cents a farmer can get a printout listing the prices of any agricultural commodities sold at surrounding markets."[12]

It is indeed true that all of these, with a very few exceptions, are still in the nature of pilot projects. But they do demonstrate the potential of ICT to help improve governance, make the state more citizen-friendly, empower the poor and ensure the better delivery of improved social services to India's poor. If these experiments can be replicated across the country, ICT can indeed contribute to the reduction of income poverty and an improvement in human development indicators.

II: The Constraints

The optimism generated by these opportunities that ICT generates has been tempered with caution because of the innumerable constraints that operate on the realisation of this potential. Among the constraints are the following:

- Substantial non-technological barriers to entry outside the realm of production
- Difficulties in appropriating the fruits of the technological advances generated by new entrants prior to being swamped by competition from financially stronger incumbents

[11] K. Venugopal, "Computers in farm land", **Business Line**, Chennai, 22 February 2000.
[12] Celia W. Dugger, "Connecting Rural India to the World", **The New York Times** Sunday, May 28, 2000.

- Limits to physical access to the new technology and the high costs of ensuring such access to the less well endowed
- Foreclosure of access because of the insufficient capabilities of large sections of the population in both developed and developing countries, especially the latter.

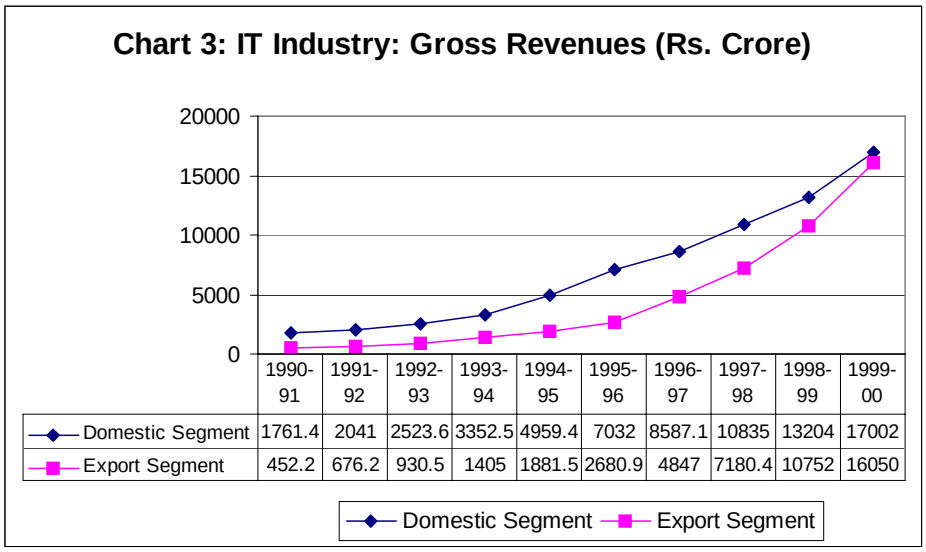
In what follows we attempt to answer, based on the Indian experience, the following questions emerging from the above discussion. First, is the optimism (bordering on hype) about the output, employment and export opportunities offered by the new technology in the hardware, software development and IT-enabled services areas warranted? Second, is the view that the ICT revolution is likely to dramatically change the current scenario of a persistingly unequal international economic order valid? And, finally are expectations that ICT would help address poverty and the social insecurities of the poor rather than generate a new "digital divide" grounded in reality?

Impact of ICT on Growth and Employment

Many observers treat the current decade in India as being one in which information technology would lead the nation onto a whole new trajectory of growth. The emphasis here is on the prospect of a major breakthrough in the export of software and IT-enabled services. In the information sector, where the availability of evidence and hard analysis contradicts its own nomenclature, the National Association of Software and Service Companies (NASSCOM) is an influential resource centre. It is also the source of extremely optimistic projections quoted earlier of the likely growth of the information technology sector. According to NASSCOM: "The idea here is that by 2008, the NASSCOM group of companies would have created several globally competitive industries, unleashing growth that will have changed India's economic fortunes."

Such projections are no doubt of use to an industry association that McKinsey reportedly declared "has played an instrumental role in facilitating business and trade in software services and in advancing research in related technology" and that is a major lobbyist for concessions to the software and IT-enabled services sector. But they may not constitute a valid extrapolation based on the current size, structure and potential of India's IT sector.

It is true that the recent boom in the IT industry, if sustained over the next decade, can lead to results of the kind forecast by McKinsey. Dataquest estimates that the total revenues of the Indian IT industry rose from Rs.22.14 billion in 1990-91 to Rs. 97.13 billion in 1995-96 and Rs. 330.52 billion in 1999-00 (Chart 3). (Dataquest's revenue figures for 1999-00 more or less tally with those put out by NASSCOM, which estimates IT revenues in that year at Rs. 336.9 million.) This amounts to a compound annual rate of growth of nominal revenues of 36.5 per cent per annum. While this is indeed a remarkable rate of growth, albeit from a small base, the sector still remains small relative to the rest of the economy. The gross revenues of the IT sector in 1999-00 amounted to 1.9 per cent of GDP.

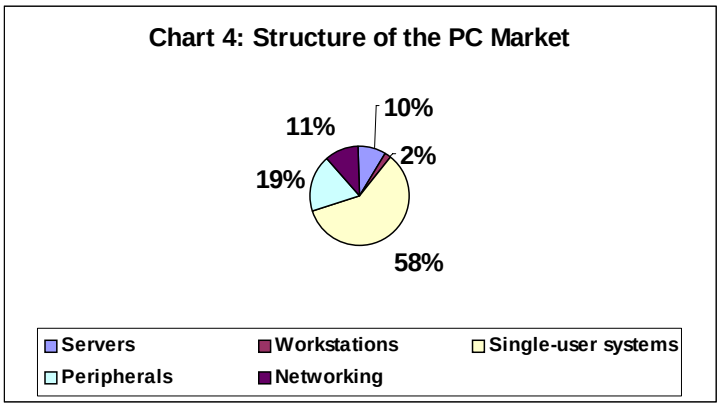


Source: Dataquest, New Delhi, Vol. XVIII No. 13, July 15, 2000.

A major contributor to the rapid growth in industry turnover is the export segment. Exports, which contributed 20 per cent of gross revenues in 1990-91, rose sharply to account for as much as 49 per cent of revenues by 1999-2000. Even in dollar terms software exports have risen at a remarkable rate, from an estimated $150 million at the beginning of the decade to close to $4 billion in 1999-00. According to NASSCOM, software exports in dollar terms increased by 57 per cent in 1999-00. But this faster expansion of export revenues should not be allowed to cloud the fact that domestic IT spending was also rising rapidly during these years. While the export segment grew at a higher rate of 39.9 per cent per annum, the domestic segment also grew at a rate of 26.6 per cent in nominal terms.

These rapid rates of growth should however be treated with caution, especially in the domestic sector. Gross revenues are misleading in an industry segment characterised by substantial dependence on imported capital goods, components and software, especially in the hardware and packaged software sectors. Of the 51 per cent of revenues generated from the domestic segment, 28.9 per cent was due to hardware, 4.9 per cent on account of packaged software, 3.6 per cent on account of training, 4.7 per cent on account of maintenance, and only 8.9 per cent on account of domestic software services. With hardware and packaged software accounting for two-thirds of domestic IT, their high import intensity would substantially reduce the domestic multiplier effects of such spending.

There are a number of reasons to expect import intensity to be high. The domestic industry does not generate much packaged software, so that a substantial part of spending on this account would amount to leakage from the domestic economy. Even in the case of hardware, import intensity tends to be high, especially in the case of servers, workstations, networking hardware and peripherals, which together account for 42 per cent of the market (Chart 4). Finally, in the case of single-user systems two developments are likely to have increased import intensity over time. First, liberalisation of component imports and reductions in import tariffs would have encouraged all producers to increase the share of components outsourced from abroad. Second, import liberalisation and the relaxation of regulations on foreign firms, has increased the share of major international players in the domestic PC market.



Source: Same as Chart 3.

Initially the Indian hardware sector, which was more or less limited to domestic firms, consisted of three segments. Premium producers like Wipro, which controlled the market consisting of quality-conscious customers, who demanded a large and reliable after-sales service network and were willing to pay a higher price for these features. Large volume retailers like Sterling Computers and HCL, which kept prices down by pushing volume sales while limiting overhead costs and accepting lower per-unit margins. And a large number of assemblers with low overheads, a small employee-base and virtually no after-sales service, who catered to price-conscious customers willing to take quality risks. According to International Data Corporation (India), vary small assemblers selling less than 200 units annually accounted for close to 50 per cent of the market for assembled PCs (Table 3).

Table 3: Assembler Type (Units sold per year, 1998-99)	
Size	Share of the market in unit terms
A (more than 1000)	21.60%
B (401-1000)	14.30%
C (201-400)	15.60%
D (up to 200)	48.50%
Total	100.00%
Source: IDC (India) website.	

These small producers most often used inputs obtained from suppliers who had managed to evade customs duties. This reduced their costs substantially. Besides, these firms were satisfied with extremely low margins. As a result their prices were much lower than that of the large domestic suppliers. Not surprisingly, the market catered to by the assemblers as a group was by no means small. For example, during the first six months of 1998-99, PC assemblers accounted for a 53 per cent share of units sold in the Indian market and a 45 per cent of that market in terms of value.

The large premium producers defended their prices on the grounds of being technologically superior, of offering better quality and of providing far more reliable after-sales service facilities. In practice, having invested much in marketing to build their brand images, these large suppliers used the protection afforded by the government to garner large margins on their sales, but did little to build brand loyalty in the domestic and international market. Neither did the government intervene to ensure that the period of protection was used to build technological capability and viable sales volumes.

As a result, in the wake of liberalisation the industry has seen significant changes in structure. Liberalisation has resulted in the gradual conversion of some premium producers into domestic

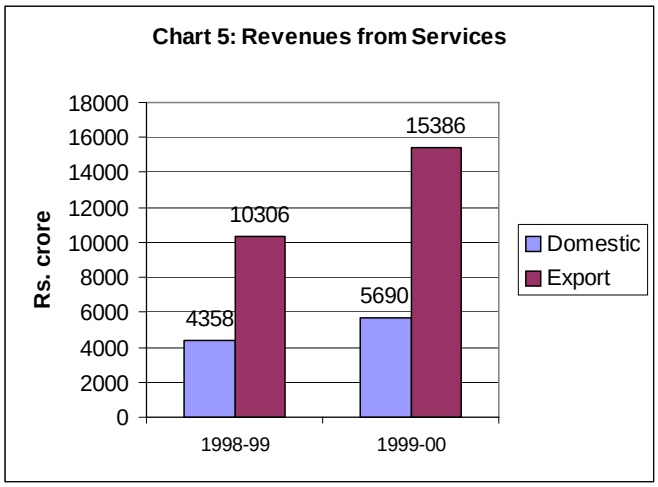
sales agents for international firms. Wipro for example has virtually discontinued its own range of products and has become a supplier of Apple and Acer products. It has also resulted in the closure of at least some large volume retailers such as Sterling, though some other large producers like HCL have remained in the PC business. Finally, as the volumes sold by multinational brands increase and duties on imported components fall, there has been a growing threat of erosion of the market share of assemblers by these international suppliers.

As Table 4 shows, in 1999-00, there were only two major domestic players who were involved in retailing volumes larger than 50,000 PCs a year and about a third of the top 15 PC brands in India were known international brands. The tendency for these suppliers to source virtually knocked-down kits from production facilities abroad is known, resulting in a high and growing import intensity in the industry. This implies that the output and employment implications of the rapid growth of domestic hardware spending would be far less than suggested by the gross revenue figures.

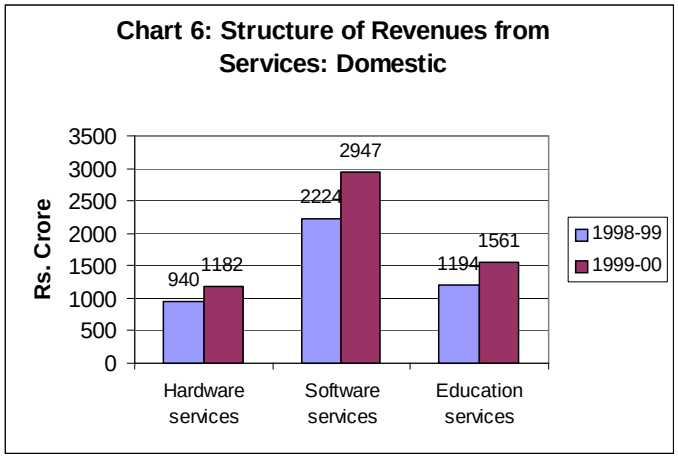
Table 4: Major PC Vendors in the Domestic Market

Vendor	Units
HCL	101500
Compaq	79484
Hewlett-Packard	63000
Zenith	59685
Wipro	49000
IBM	40534
Minicomp	27260
Vintron	20598
Acer	18000
PCS	17500
Visualan	16570
Dell	15500
SNI	10000
Apple	9000
Accel	6480
Computech	5893
CMS	5000
Others+assembled	580231
Total	1,125,235
Source: Same as Chart 3.	

For these reasons the domestic market for hardware, which has grown rapidly from a small base, is unlikely to generate waves elsewhere in the economy. A substantial proportion of the benefits of such growth are likely to accrue abroad. The real promise held out by the IT sector, therefore, is in the sector offering a range of IT-related services. Here, it is the export market that provides the real opportunity. As Chart 5 shows, revenues from services in the domestic market are currently just above a third of that from the export market, and the ratio of domestic revenues to export revenues fell from 42 per cent to 36 per cent in the course of a single year (between 1998-99 and 1999-00).

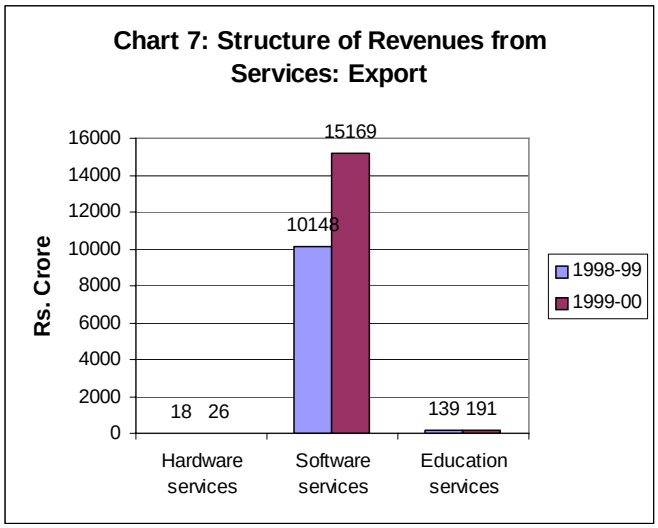


There are three broad categories into which such services fall. Hardware services, including maintenance of the growing installed-base of computers; educational services, which generate the skilled and semi-skilled personnel needed to sustain IT-sector growth; and software services, including the production of software packages, generation of customised software and the provision of a range of IT-enabled services. In the domestic market, revenues from software services, at Rs. 2947 crore in 1999-00, was only about as much as the combined revenue from hardware and educational services totalling Rs. 2743 (Chart 6). That is, not only were domestic service revenues small, but revenues from areas such as maintenance and the creation of basic IT skills generated as much revenue as the production of IT-enabling software. This is of significance because a large domestic software services market provides the workplaces for training for software personnel and the base for generating the skills necessary to meet the higher demands of the export market and to graduate to the higher end of the software value chain. That base is crucial since a substantial part of revenues from IT-related educational services is known to accrue to teaching shops that do not develop adequate skills among its students. A growing disproportionality between the market for domestic and export software services, therefore, constrains the ability of the system to generate the wherewithal in terms of the personnel needed to service the export market. This is the first factor to take account of when making judgements of India's potential in the export of software services.



To return to the point made earlier, the ability of the IT sector to "unleash growth that will change India's economic fortunes" depends largely on revenues from exports of services. As is to be expected, software services dominate the export of IT services, accounting, at Rs. 15169

crore, for 99 per cent of such exports (Chart 7). This is where the income and employment gains are going to be registered, as suggested by the fact that such exports grew by close to 50 per cent in 1999-00. Optimism on this count is driven by a number of features of the international software market. First, the importance of outsourcing. According to IDC, out of a global market of $220 million for computer services in 1995, as much as $68 billion was outsourced. Outsourcing totalled $16 billion in the case of customised software development, $32 billion in systems integration, $11 billion in IT consulting and $9 billion in business services. Compared with this, India's current exports of $4 billion of software services and IT-enabled services appears small. The opportunities are therefore substantial.



Second, the shortage of software professionals in the developed countries could result in an increase in the share of computer services outsourced. According to the OECD's *Information Technology Outlook 2000*: "A recent study based on responses to a telephone survey of 532 IT and non-IT companies with more than 100 employees found that there were some 346,000 IT positions currently vacant in the United States in three core IT occupational clusters (programmers, systems analysts, computer scientists and engineers). In addition, there were 240,000 vacancies in areas such as technical writing, training and sales. An earlier study estimated a shortfall of nearly 1 million software professionals in Japan. Even if these figures are high, most observers agree that, in developed countries, demand for skilled software professionals has grown rapidly and may exceed supply."[13]

Third, the much lower cost at which software professionals can be accessed in India. Wage costs in India have been estimated at one-third to one-fifth of US levels for comparable work (Table 4). Taking all costs into consideration, some estimates suggest that the cost of software development in India is half of that in the US. Relative to outsourcing competitors like Ireland wages in India are estimated at a half to a third.

Finally, the rapid growth of software services exports from India noted earlier, which suggests that India has the managerial ability to exploit that competitive edge. The number of Fortune 500 companies that are outsourcing their software requirements to India has steadily grown to 185. The number of software exporting companies has also grown to 1250.

Table 4. Salaries[1] of software professionals in the United States and India, 1997		
	United States	India[2]

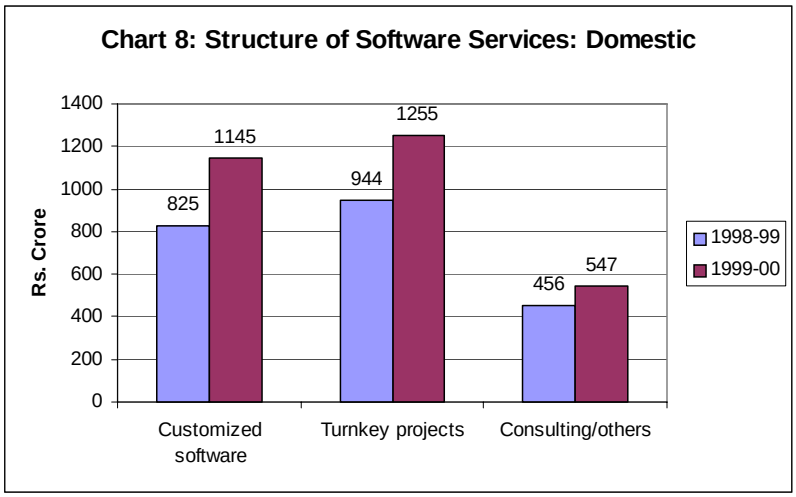
[13] Organisation for Economic Cooperation and Development, **OECD Information Technology Outlook 2000: ICTs, E-Commerce and the Information Economy**, Paric: OECD, 2000, p.131.

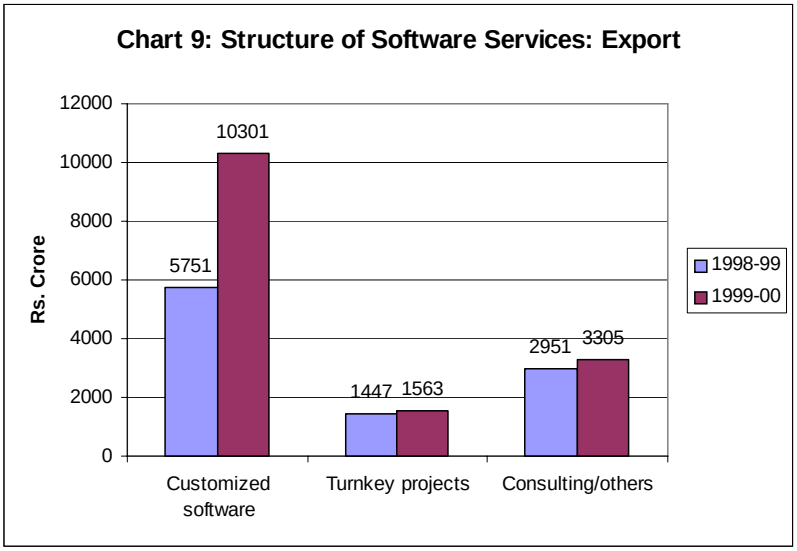
	(USD per annum)	(USD per annum)
Help-desk support technician	25 000 - 35 500	5 400-7 000
Programmer	32 500 - 39 000	2 200-2 900
Network administrator	36 000 - 55 000	15 700-19 200
Programmer analyst	39 000 - 50 000	5 400-7 000
Systems analyst	46 000 - 57 500	8 200-10 700
Software developer	49 000 - 67 500	15 700-19 200
Database administrator	54 000 - 67 500	15 700-19 200
1. Figures are starting salaries for large establishments employing more than 50 software professionals. They may be marginally lower for smaller firms. Salaries for a particular designation vary owing to factors such as educational and experience profile of the professional; platform of operation; nature of the assignment (contract/full-time); location of the employer; and additional technical/professional certification.		
2. Converted at exchange rate of INR 41.50/USD.		
Source: INFAC, Bombay quoted in OECD Information Technology Outlook, 2000.		

There are three prerequisites for the potential suggested by the above factors to realise itself. First, India software exports needs to diversify in term of sources and destinations. Of the 1250 companies exporting software services, those exporting more than Rs. 100 crore (about $22.5 million) stands at just 37. The top 25 exporters accounted for 61 per cent of export revenues in 1999-00. And the US market dominated in terms of destination accounting for 62 per cent of exports as compared with Europe's 23.5 per cent.[14] Second, Indian software service providers should be able to sustain the quality of services offered by inducting appropriately qualified and skilled personnel to not merely write code but design systems. Third, Indian firms should be able to migrate up the value chain, so as to ensure a growing share of the market as well as enter into segments that offer higher value per employee.

In all these areas the availability of personnel is bound to prove a constraint. The inadequacy of training services resulting from the proliferation of poorly-staffed, profit-hungry teaching shops, and the limited base for training and skilled-development in the domestic software services segment has already been noted. As a result even as an outsourcer India still remains a lower-end software supplier and a supplier of IT-enabled services. As Chart 8 and 9 show, unlike in the domestic market, generation of customised software or generating code for systems specified by clients dominates both the export software services market, accounting for 69 per cent of the total. As has been repeatedly emphasised, this often involves just body-shopping in the form of temporary export of software professionals to undertake specific jobs in large projects designed and executed in the West.

[14] "Software sales on hard drive", **The Economic Times**, Tuesday July 04, 2000.





What is noteworthy is that even the big exporters obtained little by way of revenues from frontline software products or higher end consultancy and software generation services. To quote a senior executive from the Indian software sector: "India, somewhere down the line, has to make up its mind whether it would be a quality software developer or concentrate on quantity…If you look at the typical structure of the IT services provided to any of the global companies – on the bottom layer is outsourcing, above it software development, on top of that is technology development and higher up is networking services and, finally, IT consulting. As you move up, you get higher billing rates, higher revenues, higher gross margins and, thereby, high profitability because the complexity of the transaction is higher." According to industry insiders like Narayana Murthy of Infosys, this move up the value chain has hardly occurred and is not India's priority. In a recent interview Murthy said Indian software expertise in customised services had a long way to go in quantity and quality before focusing entirely on other fields. ``Yes, moving up the value chain is a good idea. We are at it ourselves - about Rs. 20 crores, which is just 8 per cent of our total business and not the main," he said.[15] He said India's share of the service industry - he calls it ``customised software provision" - was only $2 billions. The market is a staggering $25 billions. India needs that kind of money, while there is

[15] R. Mohan, "Products vs Services: The argument continues", **Business Line**, Thursday, December 17, 1998, p.7.

no stopping it from reaching out to higher levels of technology. There are others, line Vinay Deshpande of NCore who feel that while software services should not be sneered at, the contract should be properly designed. ``If the job is just another cover for body shopping, then there is little technology that accrues to the contractor… Except a few, such contracts mainly mean deputing engineers from here. The parent company does not get any fresh infusion of technology in this case. I strongly believe that even in service industries, contracts should be such that there is technological upgradation." He feels technology thus acquired could then be leveraged to develop indigenous products for, in the long run, the money is in developing products.

Further, it is not clear how much of this export revenue is little more than the sale of cheap skilled and not-so-skilled IT-enabled labour services whose output is transmitted via modern communication technologies to sites where those services are required. The possibility of such service delivery has helped India circumvent the obstacle to service exports created by immigration laws in the developed countries. That is, a large part of software exports is not very different from the exports of nursing, carpentry, masonry and other such services, except for the fact that unlike those exports, the presence of the service provider at the point of sale is not required in the case of IT-enabled services.

Thus, conceptually, India's software thrust of the 1990s is not as spectacular as it appears. It is substantially export of lower end software facilitated by the availability of cheap skilled labour. And it is in large part a technology-aided extension of the earlier waves of migration by service-providers of different descriptions: doctors, nurses, and blue-collared workers of various kinds. An expansion of that kind cannot be self-sustaining. Even in quantitative terms the latter development is not spectacular. The 'net foreign exchange revenue' to the country from migration of the old kind, captured by the volume of remittances into India, is in the range of $10-12 billion. The gross foreign exchange revenue from software exports is just $4 billion.

Understanding the Hype

If despite this not too startling performance India's IT sector is the cynosure of international eyes, it is because of number of factors. The first is its rapid growth from a low, virtually non-existent, base. The success of entrepreneurs and technologists of India origin in the leading IT centres of the world, especially Silicon Valley. The third is the rise to dominance of a few Indian IT firms and IT entrepreneurs in domestic and international stock markets. As a result 9 of the 11 Indians included in Forbes listing of the 482 billionaires in 2000 are Indians in the IT sector, many of them from India. India is now home to a new breed of billionaires: those created by an almost inexplicable rise in the values of the stocks they hold. Epitomising these changes are Azim Premji of Wipro and Narayanamurthy of Infosys. These entrepreneurs from the IT sector, along with others from the entertainment and communications area, have been creating new records in the stock markets that are not always warranted by what they have achieved on the ground.

Consider the much-publicised Wipro story. On the 3rd of January this year, Wipro's share price ruled at Rs. 2,809. In a bull run that began around the middle of the month, the share price climbed almost continuously to touch Rs. 8929 by February 18th. In a world where stock values are increasingly used to value individual wealth, this close to 220 per cent increase in the course of a month has placed Premji, who owns 75 per cent of Wipro stock, among the world's richest people.

Such stories abound, even if they are less dramatic than this example of a move from a position of relatively puny wealth by international standards into the ranks of the world's wealthiest. This easy, even if recent, movement at the apex of the wealth pyramid, has added one more cause for celebrating India's IT success. What is disconcerting is that increasingly market

capitalisation, or the value of a company computed on the basis of the price at which individual shares of the company trade in the market, has replaced real asset values as the principal indicator of company size and worth. The top 50 or 500 are now determined by many analysts not on the basis of asset value but market valuation. This is part of a larger disease which assesses the size (and ostensibly, therefore, maturity) of India's stock market based on total market capitalisation.

The consequences are dramatic. In 1990, before reform began, total market capitalisation in the Bombay Stock Exchange (BSE) was less than Rs. 100,000 crore - a level that the market capitalisation of Wipro alone crossed on February 2 this year. Aggregate market capitalisation in the BSE stands today at around Rs. 1,100,000 crore, which reflects an average increase of 100 per cent a year during the 1990s. This is not only taken as suggesting a dramatic rise to maturity of the stock market, but as reflecting economic buoyancy, even though it conveys a completely different picture than that provided by GDP growth, which averaged around 6 per cent compound a year.

This disjunction of the financial from the real sector, has led up to a rather dubious interpretation of the growing distance between real and financial growth and wealth in the country. This is that India too is home to new economy, consisting of the areas such as information technology, the entertainment 'industry' and financial services, which mediate and explain the distance between the real and financial sectors. These areas, it is argued, are the ones which define India's comparative advantage in a globalising context and are the wealth creators of the new millennium. They are the ones where India is truly part of the world community and can stand on its own. They are the true new temples of modern India, and not steel, power and heavy industry which occupied the Nehruvian mindset. Not surprisingly, according to this view, even while markets are buoyant and wealth is being almost magically created, the Steel Authority of India Limited has to be provided with a massive financial restructuring package, including a Rs. 5454 debt write off, to remain in operation.

Forget for a moment that the capabilities and skills that provide the wherewithal for the emerging businesses are a direct product of the past, which now stands condemned. Consider the true nature of the financial expansion that is occurring through India's stock markets. To start with, market values of individual shares are not a reflection of the true worth of the companies involved, but the state of demand for those shares relative to their supply. Demand, at the margin, is clearly being driven by foreign institutional investors in search of diverse portfolios, who now number more than 500 in the country.

The tastes for shares of these investors are know to be volatile, shifting across national boundaries and continents for reasons that are not easy to find. But India, it is clear, is the flavour of the times. During the first 18 trading sessions in February, the FIIs invested more than Rs. 2660 crore, which was more than half the annual average investment that occurred during the years since 1993, when FII investment in India's stock markets was first allowed. The inflow during these days was in fact higher than the inflow during the last six months of 1999. Clearly, there had then been a sudden surge of interest in India.

Three factors appear to explain this trend. First, a speculative boom in IT stocks in general and internet stocks in particular in American markets. Second, the fact that among emerging markets India is a country with a growing IT presence, in US markets, strengthened by strategic alliances with leading US firms. Finally, the fact that those Indian firms that have gone in for a NASDAQ listing in American markets were at that time performing quite well, encouraging other Indian firms in the IT and entertainment sectors to contemplate a similar strategy.

These factors had virtually ensured that the speculative fever in IT and related stocks in American markets has spilt over into the Indian market. For example, the bull run in Wipro

shares came in the wake of two major strategic alliances it had forged with Microsoft, the software giant, and Symbian, the combination of leading players targeting the emerging market for wireless devices that link to the internet.

While demand for Indian equity in selected sectors is spurred by these factors, the supply of such shares is limited for two reasons: first, internationally acceptable players are still small in number, even if increasing over time; and, second, the number of shares from such enterprises that are available in the market are limited. As mentioned earlier, only 25 per cent of Wipro shares are with the "public" as opposed to the promoter, and most of those holding such shares are unlikely to be ready to part with them in the course of a boom. The net result is that the demand-supply balance at the margin is heavily weighted in favour of sellers, resulting in astronomical price increases in short periods of time. This is true of other companies as well. Needless to say, if many promoters chose to exploit the situation by off-loading a significant chunk of their holding, the demand-supply balance for shares of individual companies could change substantially, resulting in a fall in prices that is as dramatic as the previous rise.

Despite this dependence of share prices on the limited supply resulting from a high holding by the promoter and their associates, the market capitalisation index applies the price at the margin to value the stock of the company. This results in a dramatic surge in the "market value" of the company along with the price. Not surprisingly, a few firms and sectors accounted for the early-2000 surge in market capitalisation. By mid-February, Wipro alone accounted for 15 per cent of market capitalisation in the BSE and the combined market value of around 150 software companies accounted for 32 per cent. It must be remembered that at the beginning of the 1990s, these companies hardly featured in the BSE.

In short, India's new found wealth is like a pyramid of cards built by a bunch of flighty investors. Small money by world standards is rushing into a few sectors, honing in on a few companies which have a small number of shares on trade. This pushes up prices at the margin to create an illusion of wealth even as the economy trudges along the same old growth rate, because the commodity producing sectors, especially agriculture languish. But at the top, things appear as if they could not have been better.

However, that speculative fever has given way to a sharp fall in stock prices when investors (foreign and domestic) realized that there was nothing which warranted a share to trade at 750 times the annualised per share earnings of a company, as it did in the case of Wipro. Compare to its February peak of close to Rs. 9000 per share, the Wipro stock closed at Rs. 2282 on October 20, 2000, which was the day after it made its debut at the New York Stock Exchange.

IT Growth and the State

These features of IT growth not only suggest that the high expectations from the IT sector were in part misplaced but that private responses to market incentives don't ensure the requisite changes in terms of technological development and brand-building in the hardware sector, the spread and appropriate diversification of software export activity, the adequate generation of software skills and the much-needed migration up the software export value chain. This points to the need for some intervention by the State not merely to facilitate such changes but enforce compliance along these lines on the part of the private sector. Unfortunately, the prevailing perception is that ICT-based industries are best left to private initiate and private responses to market signals. Any attempt at regulation has been interpreted as an effort to throttle the dynamism of private sector-led growth. Accepting that perspective, the Indian government has increasingly withdrawn from regulation of this sector and has even offered substantial fiscal incentives and tax concessions, especially to the exporters of software and IT-enabled services. Besides implementing and proposing to implement a zero duty regime on a range of IT

Products, the government has exempted profits from software service and IT-enable service exports from payment of income tax.

On the other had in its role as facilitator, the government has taken on a range of responsibilities including that of ensuring the expansion of educational services so as increase the supply of IT professionals and investing in and creating conditions for the rapid expansion of the IT infrastructure, especially the availability of high speed links and international gateways with sufficient bandwidth.

This policy slant has had three consequences. First, it has meant that the government has not been able to ensure adequate technology absorption and development in the hardware sector. Second, the government has not been able to intervene to ensure the migration up the value chain of India's software industry. And, finally, the government has not been able to mobilise adequate revenues from what is a rapidly growing sector, even though it is required to undertake expenditures and investment to facilitate the growth of the sector, especially its export segment, as well as to seek to realise the potential human development benefits of ICT. This is crucial given the fact that ICT is not all benign. As one analyst puts it there is: "a clear risk that, without policy intervention, ICT will intensify social divisions rather than close them. The unregulated market is likely to develop ICT to address the needs of the better educated, wealthier, and more technology literate individuals, communities and countries, since these are the people who want and will be prepared to pay for the development of new and more sophisticated products and services."[16]

Case for Caution

With the government failing to direct the sector in appropriate direction, the persistence of the current growth trends in the industry depends on India continuing to exploit the possibilities of arbitrage generated by differences in custom software and IT-enable serviced costs between onsite sources and offshore centres. There is, however, some uncertainty as to whether India can do so. That possibility is threatened not merely by the emergence of alternative offshore centres in countries like the Philippines and Israel, but also by a reduction in the onsite-offshore cost differential. There are two tendencies driving that reduction in differential. First, an inadequate pace of generation of additional, appropriately skilled software professional, for the reasons delineated earlier.

Second, the "suction-effect" exerted by software centres in the developed metropolitan countries. Learning from the success of Indian software engineers in Silicon Valley and elsewhere in the US, the United States government itself and governments in other developed countries like Germany, France and Japan are selectively relaxing their immigration laws and rules and quotas regarding the provision of work permits, to facilitate the flow of the best Indian software engineers to their countries. The attraction of the better salaries, lifestyles and work conditions in these environments ensures the rest. This has had some adverse consequences in India. To start with, it has raised the salaries paid out to top-end software professionals to close to international levels, reducing the cost advantage India had in this area. Second, it has created an acute shortage of highly-qualified, top-end experienced and skilled professionals in the Indian market for software engineers. The prognosis with regard to India's migration to the higher-end of the software supply chain based on its knowledge-advantage is, therefore, not altogether positive. That movement is possibly as structurally constrained as the effort at increasing sophisticated manufactured exports from the developing to the developed

[16] Stephen McNair, "The Emerging Policy Agenda" in Organisation for Economic Cooperation and Development, **Schooling for Tomorrow: Learning to Bridge the Digital Divide**, Paris: OECD, 2000, p. 10.

world was. It for such reasons that optimistic projections of the kind emanating from the McKinsey/NASSCOM stable should be taken with more than a pinch of salt.

The ICT Revolution and International Inequality

As mentioned earlier, in the past, the special characteristics of the IT sector, which substantially reduce technological and financial barriers to entry by small players, were seen as underlying the success of small Silicon Valley start-ups. Those start-ups not only challenged traditional giants like IBM, but also have since grown to become major players in their own right and have changed the structure of the industry. The growth of the IT industry in India and elsewhere in the developing world and India's success as a software exporter, seem to suggest that these characteristics hold for firms in developing countries as well. Not surprisingly, it is now being argued that what was true for the Silicon Valley start-ups in terms of their ability to break through barriers to entry should be true for for the developing countries. It is this perception that underlies the optimism that information technology heralds a new era of reduced international inequality.

The Hardware Sector

It should be obvious that this argument cannot be extended beyond a point, especially in the hardware sector. The core of the computing business is dominated by a capital-intensive and oligpolised product like the microprocessor, the market for which is dominated by a few producers like Intel, Motorola and AMD. And the technologies driving a range of peripherals like printers and networking products, for example, are proprietary and are not replicated without a licence. This implies that hardware production in developing countries like India amounts largely to assembly of components, much of which is imported. Indigenous content is restricted to certain of these components and indigenous technological input is confined to system architecture and design. As a result, value added domestically tends to be small.

Further, while capital investment requirements for production may be small, production for geographically and quantitatively large national and world markets require high sunk costs. This takes the form of initial expenditures on marketing, retailing and the creation of an after-sales service network. Deep pockets and/or access to large sums of capital are therefore a prerequisite for entry into this segment of the hardware sector.

When the domestic market for PCs and peripherals is relatively protected and component imports are highly taxed, a few large players coexist with a large number of smaller suppliers. It should be obvious that all segments of the domestic industry benefited substantially from the quantitative restrictions on PC imports, with premium producers garnering high margins and the lower-end assemblers surviving despite high costs and poor service. Needless to say, the small assemblers with low margins were in no position to use the opportunity afforded by protection to build capabilities of a kind that would allow them to compete with large international suppliers as and when protection was withdrawn. On the other hand, with the government not enforcing R&D based competitive production in the premium segment, and premium producers choosing to encash the large margins rather than plough them back into production, even they did not concentrate on developing indigenous sources of supply of components and accessories and on reducing costs and developing significant product innovation capabilities.

The effects of this history were seen when the government, eager to exploit India's capabilities as a software and IT-enable outsourcer decided to ease access to and lower duties on information and communication technology products. The first casualty were some producers in the premium segment who when faced with the abolition of quantitative restrictions and the reduction of duties on a range of PC products, decided they could not face up to the

competition. Some chose to become domestic sales agents for international brands. But almost all leading producers have substantially diversified out of PC production into software-generation.

This has resulted in an unusual situation in the PC market in developing countries like India, where despite a long record of PC production even by international standards, there are increasingly a few international brand names like IBM, Compaq, Dell, and HP, coming to dominate the market. As argued earlier, the implications of this for the linkage effects of the growth of the PC industry and for net foreign exchange earned by the information technology sector needs to be noted. Needless to say, with imported components accounting for a substantial share of the value of PCs assembled by both the international players and domestic assemblers, the domestic linkage effects of the growth of PC sales could only be limited. Much more employment is likely to be created by the growing demand for maintaining and servicing the installed PC base (estimated at 4.3 million). In the PC segment itself whatever value is added domestically would accrue in the hands of large international firms. Given the sourcing practices of these firms it is likely that the import intensity of PC production in India would remain high, resulting in the leakage of some at least of the revenues earned from exports of software and IT-enabled services.

These features of the PC market, which would be even truer of the peripherals market, indicate that, in the wake of liberalisation, the emergence of a strong indigenous industry that engages world markets is not likely in the hardware segment. This substantially dilutes the argument that there is likely to be a substantial restructuring of the international industry in favour of developing countries such as India, at leas so far as hardware production is concerned.

The Software Story

Thus, if the case that India is likely to emerge an IT powerhouse which invades developed country markets and challenges developed-country players is valid at all, it can only be true of the software segment. However, as argued earlier, while the aggregate figures on software exports are indeed remarkable, a closer look indicates that a few players operating at the lower end of the value-chain in software production account for much of these export revenues. This needs to change if India's advantage has to be maintained and extended.

The difficulty is that the move up the value chain may not be a matter of pure choice, but structurally limited. While there have been instances of Indian companies delivering high-end products, like the banking and e-commerce software product, BankAway, from Infosys, the industry generally accepts that much of the exports from India consists of low end outsourcing and IT enabled services. This limited success in terms of the composition of exports may be because there indeed are barriers to entry into higher end software, resulting from the fact of increasing returns in the form of sharply reducing costs as volumes increase, helping create and strengthen oligopolistic positions.

This is because knowledge products like software packages have the public good chracteristic of non-rivalry in consumption, since making the product available to one user does not preclude its availability without much additional cost to another. This essentially implies that so long as the producer and seller of that knowledge can ensure excludability, or that sale of the product to one does not lead to the replication of that package for free use by another, there are substantial increasing returns in the software sector. Producing the first unit of a software product requires large investments in its generation, whereas producing an additional unit is almost costless. The larger the sales, therefore, the lower is average cost and the higher the return.

But that is not all. When large sales imply a large share of the market as well, scale becomes a means of ensuring consumer loyalty and strengthening oligopolistic positions. This is the result of "network externalities" stemming from three sources. First, consumers get accustomed to the user interface of the product concerned and are loath to shift to an alternative product which involves some "learning" before the features of the product can be exploited in full. Second, the larger the number of users of a particular product, the greater is the compatibility of each user's files with the software available to others, and greater the degree to which files can be shared. The importance of this in an increasingly networked environment is obvious. Finally, all successful products have a large number of third-party software generators developing supporting software tools or "plug-ins", since the applications program interface of the original software in question also becomes a kind of industry standard, increasing the versatility of the product in question without much additional cost to the supplier. These "network externalities" help suppliers of a successful software package to "lock-in" consumers as well as third party developers and vendors, leading to substantial barriers to entry.

Appropriating the benefits of new technology

Take the case of software products for mass use for example. Creating such a product starts with identifying a felt need (say, for a browser once the internet was opened up to the less computer savvy or for a web-publishing programme once the internet went commercial). The persons/firms identifying such a need must work out a strategy of generating the product, by hiring software engineers, at the lowest cost in the shortest possible time. Once out, the effort must be to make the product a proprietary, industry standard. This involves winning a large share of the target consumers, so that the product becomes the industry standard in its area. Once done, the product becomes a revenue generating profit centre. The investment required is the sums involved in setting up the company, in investing in software generation during the gestation period, and in marketing the product once it is out so as to quickly win it a large share of the market. Needless to say, while entry by individuals or small players are not restricted by technology, they could be limited by the lack of seed capital. This is where the venture capitalists enter, betting sums on start-ups which if successful could give them revenues and capital gains that imply enormous returns.

There are, however, three problems here. The first is one of maintaining a monopoly on the idea during the stage when the idea is being translated into a product. The second is that of ensuring that once the product is in the public domain competitors who can win a share of the market before the originator of the idea consolidates her position do not replicate it. It is here that a feature of 'entrepreneurial technologies' – the easy acquisition and widespread prevalence of the knowledge base needed to generate new products - considered an advantage for small new entrants actually proves a disadvantage. Thirdly, no software product is complete, but has to evolve continuously over time to offer more features, to exploit the benefits of increasing computing power and to keep pace with developments in operating systems and related products. Thus large and financially strong competitors, even if they lag in terms of introducing a product 'replica', can in time lead in terms of product development, and erode the pioneer's competitive advantage.

There are two aspects of technology that are crucial in this regard. First, their source. Second, the appropriability of the benefits of a technology. As mentioned earlier, in industries with routinised technologies the source of technology was in significant part the activity of incumbent firms themselves. On the other hand, in the case of entreprenurial technologies the sources were in the public domain. This was where the advantage lay for the small operator. But once a technology is generated based on some expenditure in the form of sunk costs, there must be some way in which the innovator can recoup these costs and earn a profit as incentive to undertake the innovation. In the Schumpeterian world this occurred because of the 'pioneer

profits' that the innovator obtained. The lead-time required to replicate a technology itself provides the original innovator with a monopoly for a period of time that generates the surplus which warrants innovation.

Most often this alone is not enough to warrant innovation and in the software sector lead times can be extremely low, especially if the competitor invests huge sums in software generation, reducing the lead-time substantially. It is for this reason that researchers have defended and invoked the benefits of patents, copyright and barriers to entry in production, which allow innovators to stave off competition during the period when sunk costs are being recouped. Unfortunately, neither is the status of patents and copyrights in the software area clear (as illustrated by the failure of Apple to win proprietary rights over icons in user interfaces), nor are there barriers to entry into software production.

This has had two implications. First, the importance of secrecy in the software business. The 'idea' behind the product must be kept secret right through the development stage, if not competitors can begin rival product developments even before the original product is in the market. A feeble attempt to institutionally guarantee such secrecy is the now infamous 'non-disclosure agreements' which prospective employees, financiers and suppliers are called upon to sign by the innovator who is forced to partially or fully reveal his idea. Secondly, even after the product is out, since the threat of replication remains, it is necessary to strive to sustain the monopoly that being a pioneer generates. This is where the possibility of locking in users with the help of an appropriate user interface which they become accustomed to and are reticent to migrate away from, and locking in producers of supportive software with an appropriate 'applications programming interface' becomes relevant. It should be obvious that sustaining monopoly to recoup sunk costs can indeed be difficult.

Such strategies did help the early start-ups, resulting in the jeans-to-riches stories (Microsoft, Netscape, etc.) with which Silicon Valley abounds. But more recently it has become clear that start-ups undertake innovative activities only to create winning products that the big fish acquire. This is because of the possibility of easy replication and development of an original product, which can be done by dominant firms with deep pockets that allow them to stay in place and spend massively to win dominant market shares. In the event, the likelihood that a small start-up would be able to recoup sunk costs, clear debts and make a reasonable profit is indeed low. Selling out ensures that such sums can indeed be garnered. And selling out is often a better option than investing further sums in developing the product, now faced with a competitive threat, in keeping with industry and market needs.

Given this feature of the software products market, it is not surprising that small players (such as Netscape with it Navigator and Vermeer Technologies that delivered Frontpage) are mere transient presences in key areas even in the developed countries. To expect developing country producers to fare better is to expect far too much. The latter can merely be software suppliers or outsourcers for the dominant players.

The Internet economy

Much of what has been said above about the software economy seems to be true of the internet economy as well. The following quote from a recent story in the *Financial Times*, London[17] is quite revealing:

> As dotcom companies burn up their cash and fundraising opportunities evaporate, it seems certain the rout will continue. But less clear is where it will stop. Could it end with just one internet leviathan dominating the business-to-consumer market? A

[17] Richard Tomkins, "Dotcoms: How long will the rout continue", **Financial Times**, London, October 22, 2000.

> Yahoo.Ebay.Amazon.com that serves all the consumer's needs? The internet is often regarded as the most open and entrepreneurial market in history. In theory, there are few barriers to entry: almost anyone can start a business, without the need for large amounts of capital or a big factory. So as some companies die, others should spring up in their place, offering new features, better service or lower prices. Yet as the business-to-consumer market develops, there are signs that it is becoming an online version of the winner-takes-all society: one in which two or three companies at the top take a vastly disproportionate share of the market, making it difficult for others to thrive. The consolidation is one such sign. Another is the way that advertising revenues - for many dotcom companies, the main or only source of income - are disproportionately favouring the most popular sites. According to latest figures from the Internet Advertising Bureau, an industry group, 71 per cent of US dotcom advertising revenues are going to the top 10 sites, 83 per cent to the top 25 and 91 per cent to the top 50. The IAB does not say which sites are getting most of the revenues, but it is not much of a mystery. The advertisers want to be where the eyeballs are, which overwhelmingly means the big-name portals such as Yahoo!, MSN and America Online. "The big are getting bigger," says Tom Hyland, chair of PwC's new media group in New York, which conducts the IAB survey. Sites that attract the most viewers get the most advertising revenues, he says, which in turn means they can offer more services and attract even larger audiences. "It's a natural evolution in the industry that will continue to play out."

This implies that, given the current trends in the industry, even on the software and internet economy fronts the promise of ICT contributing to a redressal of even national, let alone international, inequalities in technology and income is unlikely to be realised. The digital world seems to adding to and even worsening the existing divide.

Human Development Benefits

The international digital divide, between the developed and developing countries is obvious. Twenty of the world's largest developing nations contribute only about 27 per cent to the global information technology market of $750 billion. Less than 5 per cent of the world's population is a participant in the internet revolution, involving 330 million users and 1.8 billion web pages, which are increasing at the rate of 150,000 users and 2 million pages every day.[18]

However, the real threat of a digital divide is, of course, within the country itself. This arises from a number of sources. First, the fact that an overwhelming majority of the population is likely to remain excluded from the benefits of the new technology. Second, that even to the extent that access is available, inadequate education would ensure that the majority would not have the competence and the confidence to participate in the transformation that the technology is likely to effect in the work practices and lifestyles of the urban and rural elite. To quote Donald J . Johnston of the OECD: "The machines and sophisticated ICT equipment are useless without the competence to exploit them. Nurturing this competence is in part the jobs of schools and colleges, where the foundations of lifelong learning and "technological literacy" are laid. In part, it is dependent on the learning that takes place in homes, communities and workplaces. Education and learning are now the lifeblood of our 21st century knowledge societies, and ICT has become integral to them. The gaps that define the "learning digital divide" become as important as the more obvious gaps in access to the technology itself."[19] Finally, even as access grows, the rapid changes in ICT and its use would result in many with initial access falling behind in their ability to continue to use the benefits of the technology.

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[18] "Third World contributes 27% to $750 billion IT market", **Economic Times**, Delhi, 21 July 2000.
[19] Foreword to Organisation for Economic Cooperation and Development, **Learning to Bridge the Digital Divide**, Paris: OECD, 2000, p. 4.

The prospect is disturbing when we begin to examine the figures. According to Government of India, in 1998-99, the penetration of PCs in the country was only 3 per thousand and the number of fixed telephone lines to connect to the world wide web through an ISP only 22 per thousand. By that time half the US population had access to PCs and the worldwide average penetration was 60 per thousand in the case of computers and 125 per thousand in the case of telephone lines. Even after taking account of the optimistic projections of IT growth to 2008, PC penetration is expected to touch only 20 per thousand and fixed telephone penetration just 100 per thousand. In the circumstances the impact of IT on the nation as a whole can only be marginal.[20]

Much of even this extremely limited access is concentrated in urban India. Trying to accelerate penetration through schemes like the Warana "wired village" project, which the government's IT Task Force has recommended should be replicated across India's villages, would of course be impossibly expensive. As mentioned earlier, the Warana project, which connected and computerised a cluster of 70 villages, was estimated to have cost $600,000. There are around 550,000 villages across India. If costs of replicating the experiment across these villages remains the same, the total cost would amount to around $4.7 billion. This amounts to close to 12.5 per cent of India's GDP in 1998-99. This compares with the fact that public expenditure on education as a proportion of GNP stood at 3.2 per cent in 1995-96 and on elementary education at just 1.5 per cent and that even the Indian government's unimplemented commitment in this area is to raise the expenditure on education to just 6 per cent of GDP. It would, of course, be argued that "wiring costs" are one time costs. However, such an estimate of one time costs does not take into account the subsequent of maintaining and continually upgrading these facilities, in the context of rapid technological changes, which could be as much as up to half are more of the initial costs.

This difference in actual expenditure on education and the required expenditure on wiring India's villages is not without significance when we recall Johnston's view quoted earlier. Even as late as 1997, NSS data revealed literacy among the population above 7 years of age was just 62 per cent. The literacy requirement is set so low that in most cases being literate would be inadequate to be competent enough to become digitally literate. A minimum of school education would be a prerequisite beyond a point. Here the picture is dismal. To quote the Public Report on Basic Education in India[21], "at the time of the 1991 Census and the National Family Health Survey (1992):

- Half of the country's population (61 per cent of women and 36 per cent of men, aged 7 and above) was unable to read and write.
- Less than 30 per cent of all adults had completed eight years of schooling.
- One-third of all children aged 6-14 years (about 23 million boys and 36 million girls) were out of school."

What these figures suggest is that building capacity to exploit the benefits of ICT requires investment in developing literacy and skills among those beyond the school-going age, who would be the ones immediately affected by the structural transformation that IT effects. Further, what the ICT revolution demands is a process of lifelong learning, since the rapid changes and continual upgrading of these technologies places newer demands on those

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[20] Government of India, Ministry of Information Technology, **Annual Report 2000**, New Delhi: MIT, 2000.

[21] The Probe Team, **Public Report on Basic Education in India**, New Delhi: Oxford University Press, 1999, p. 9.

participating in the 'new economy'. Participation is a must if individuals are not to remain disconnected, since it is easier for those who already possess skills to upgrade them further.

Finally, given its sources, the information economy transacts principally in the English language. This also means that much of the software needed to be a digital citizen requires, as of now, familiarity with English. This implies that non-English speaking countries should invest either in the generation of software in the vernacular or in developing English language skills, or both. This makes the costs of "catching up" all the greater. A large part of this investment must be undertaken by the State, since the market is unlikely to service these needs.

This creates a dilemma. Not investing in ICT is to forego what happens to be the leading opportunity in modern economies. But excessive emphasis on IT could result in the diversion of resources away from the much more crucial expenditures on literacy and primary education, which are not just development goals in themselves but a must if the digital divide is not to widen rapidly.

Implications for Policy

In brief, the fall-out of the above analysis of the constraints to the realisation of the potential of ICT is the following:

- Despite its rapid growth the information technology sector in India is small and marginal and the fall-out of its growth on the rest of the economy is limited.
- There are signs that barriers to entry outside the realm of production in both the hardware and software segments are substantial. This has adverse implications for sustaining the growth of both output and employment in this sector, unless the disproportionality in growth between the domestic and export segments is addressed and firms strive to strengthen domestic hardware production and move up the value chain in software. This requires the State to play a more proactive role in influencing the pattern of growth of this sector, rather than leave matters to the market which drives firms in the direction of the lower-end of the value chain, where entry is easier and profits quick to come by.
- Despite the rapid growth and high profitability of leading firms in the software and IT-enabled services sector, the notion that this is a sector whose growth is best left to the market, has resulted in fiscal concessions of a kind that substantially reduce the revenues garnered by the State. This substantially erodes the ability of the State to sustain even its role as facilitator (which involves large investments in the communications infrastructure), let alone providing funds to expand its role in the area. The industry must contribute out of its large profits a part of the revenues to meet the much needed expenditures by the State in this area.
- The State's role is all the more crucial when we examine the prospect of a sharply widening digital divide within the economy. Even beginning to provide access to the new technology to the overwhelming majority who cannot access it for technological reasons would impose a large financial burden. But the more difficult task is to prepare the disconnected to develop the competence to participate, however marginally, in the emerging digital economy. This alters priorities completely. With literacy and schooling achievements still at indefensibly low levels, the first task of the government would be to rapidly advance the pathetic reach of literacy and school education in the country. In terms of priority this should be placed above the target of providing a minimum degree of access to ICT those who are completely disconnected. However, the nature of the challenge of overcoming backwardness is such that a degree of

syncopation is inevitable, necessitating large resources which in part must come from the surpluses being garnered by the rapidly growing and highly profitable IT services sector. Thus the growing dilution of the State's role in the growth in the IT sector could aggravate the tendency to widen the 'digital divide' between India and the developed industrial countries, especially the US, and within India itself to persist and even widen. This strengthens the argument that the buoyant and highly profitable private sector has to be treated on par with the "brick-and-mortar" economy and taxed to generate the resources for such expenditures.

- This need to push for greater expenditure by the State is in the interests of the industry as well for two reasons. To start with, a widening digital divide can only widen social divisions and tensions. To quote one analyst: "a clear risk (is) that, without policy intervention, ICT will intensify social divisions rather than close them. Easy access to ICT enables people to become richer and therefore more able to afford still newer technology; it is moreover the already educated who – disproportionately – take up lifelong learning activities and who, in general, get better services. In short, the educated *information rich* become richer and the less educated *information poor* become poorer."[22] No democratic society can tolerate growing divisions of this kind, making effective State intervention an effective policy option for the industry as well. Second, as the infrastructure and the capacity to participate in the transformation being wrought by ICT expands, it not only expands the market for the domestic industry but also allows it use the large domestic market as the base to generate the skills and develop the capability to move up the value chain in both hardware and software production. Thus partnership between the State and private capital rather than free play for private initiative, with State as mere facilitator, is what is required to even begin to meet the challenge that the IT revolution sets for a developing country like India.

[22] Stephen McNair, *op. cit.*, p. 10.